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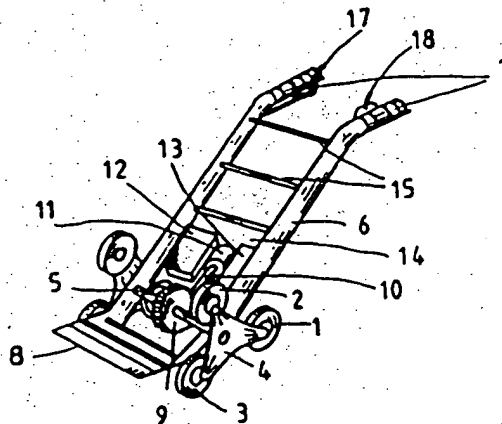


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## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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(54) Title: STAIR CLIMBING HAND TRUCK



## (57) Abstract

A stair climbing hand truck of the kind comprising a rotary holding means carrying supporting wheels arranged setwise in starlike configurations where the holding means (4) for a starlike configuration of supporting wheels (1, 2, 3) is rotary positioned and may be rotated by means of a drive means (11) which is either of the self-locking kind, as for instance a drive means comprising a worm gear (9), or is able to be locked, by means of a disengageable braking- or locking mechanism, in a chosen and attained position after a terminated rotary movement. In this way, an embodiment which, compared to the known hand trucks of this kind, requires lesser energy supply is attained as well as a larger amount of kinds of stair cases is suited for the hand truck. Furthermore, it is attained that it is more easy to lift goods up on the hand truck which for instance may be constructed as a sack truck.



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# Stair Climbing Hand Truck.

The present invention relates to a stair climbing hand truck of the kind comprising a rotary holding means carrying supporting wheels arranged setwise in starlike configurations.

It belongs to the state of the Art to construct hand trucks, such as two-wheeled sack trucks, in such a way that the usual and single carrying wheels are substituted by two or three or more wheels arranged in starlike configurations within the single planes of the original wheels. The diameters of the single wheels are preferably equal. Such starlike configurations of the wheels is for instance described in the contents of the Danish patent application no. 2568/82. According to this known embodiment the holding means which provide the starlike configurations at the positions previously being occupied by the supporting wheels comprise eccentric positionings of the carrying and rotary axes for the holding means, so that the rotary movement of the wheel configurations not is forced to take place than in case one or more of the foremost wheels belonging to the starlike configurations, due to being foremost in a chosen drive direction, hereby hit an obstacle such as a step of a stair case and due to the further movement of the truck are providing a rotary movement of the holding means resulting in positioning the next supporting wheel of the starlike configuration on the land area of the step of the stair case being present as the obstacle. By further movement of the truck the rotary movement of the holding means continues and first terminates when the wheel now being the rearmost rests against the same land area of the step as the wheel first being rotated to rest against the land area. The forward moving then continues to the now foremost supporting wheel hits the next step of the stair case, etc. - This Danish patent application also comprises a description of a drive mecha-

nism comprising a kind of internally toothed driving rim enabling a synchronously driving of the single supporting wheels belonging to the starlike configurations.

This embodiment according to the state of the Art suffers under some drawbacks. Driving on a horizontal floor always take place with two wheels belonging to the single starlike configurations resting against the floor, and this naturally provides friction problems between the wheels and the floor when driving around sharp corners.

Furthermore, the person using the hand truck himself mainly have to provide the power which is needed to turn the holding means when climbing stairs of a stair case.

Furthermore, it is comparatively easy to drive a hand truck as a sack truck on a horizontal floor when the floor is not all too uneven. But this situation is not the one which generally occurs and has to be especially considered. So where the aid of a driving means is needed, and as usually battery driven electromotors are employed as driving means, a comparatively large battery weight is present making the truck more heavy, but this results in the manually rotating of the holding means belonging to the starlike configurations of the supporting wheels becomes correspondingly more difficult to perform. To avoid the drawbacks:

It is the purpose according to the present invention to provide another construction of hand trucks comprising supporting wheels arranged in starlike configurations, so that the same resulting performance is achieved also when employing batteries of a lower capacity, and where the truck is more easy to handle when climbing obstacles such as stairs of a staircase, and where the demands to the physical shape of the stairs is less strict than required when using hand trucks of known structures.

This is according to the present invention achieved when the holding means for a starlike configuration of supporting wheels is rotary positioned and may be rotated

by means of a drive means which is either of the self-locking kind, as for instance a drive means comprising a worm gear, or is able to be locked, by means of a disengageable braking or locking mechanism, in an attained position after  
5 a terminated rotary movement.

By means of such an embodiment all drawbacks in total are eliminated. The hand truck may thus be employed manually pushed or pulled on grounds or floors without obstacles. As soon as the foremost wheel of the starlike  
10 configuration in the drive direction of the hand truck reaches an obstacle, such as a stair of a stair case, the drive means manually or possibly by means of a sensor becomes activated to drive the holding means forward so that a supporting wheel of the starlike configuration is  
15 brought to rest against the land area of the stair of the stair case, whereupon the drive means is brought to proceed some what further unto the supporting wheel is rotated upwards to be in level with the wheel resting against the land area of the stair of the stair case, after which  
20 the hand truck can be driven further on towards the next obstacle. The reverse action takes place in case an obstacle as the uppermost stair of a stair case leading below is going to be met from the upper end. In this case the hand truck is stopped just before the downward leading  
25 stair case is met and the holding means is activated to rotate the holding means forward by means of the drive means which either is manually engaged or possibly is engaged by means of a sensor. Herethrough, a supporting wheel is brought to rest against the thus lower positioned  
30 land area, and the drive means is brought to proceed to a further supporting wheel rests against the land, and the hand truck is pushed forward to the next obstacle, which may be either upwards leading or downwards leading. It is evident hereof, that, contrary to the state of the Art, it  
35 is not necessary to exert a pushing or pulling force on the

the hand truck to overcome an obstacle, on the contrary, the drive means even perform the function of lifting or lowering the hand truck so that it only is necessary to push or pull the hand truck in horizontal direction or in slanting direction on grounds or floors being sufficiently smooth for the purpose.

Furthermore, the present invention presents the advantage that by taking-up or delivering of goods with a hand truck, which for instance is constructed as a sack truck, the drive means may be used to lift or lower the sack truck end being thus the most heavy, as the drive means is brought to rotate clockwise or anti-clockwise, and due to the locking of the drive means or subsidiary of the holding means in the attained transportation position driving of the hand truck may take place on only two supporting wheels and not on the minimum which counts four wheels as it is the case at hand trucks constructed according to the state of the Art. In this way better drive performance around sharp corners is achieved.

As mentioned in claim 2 it is, to support the attained advantages, advantageous if according to the invention the activation of the drive means or of a possible braking- or locking mechanism is manually providable by means of activating means being arranged at the steering handles on the hand truck. Another but important feature is achieved when, contrary to the usual practice according to which the drive means, most often being of electric kind, are unevenly distributed in the truck, the drive means to achieve the best possible position in the truck is located underneath the cargo and in the near neighbourhood of the set of supporting wheels. It has been tried to construct the truck so that the drive means through a worm gear, having output shafts pointing out to both sides in relationship to it, directly drives two holding means pertaining to a hand truck constructed as a sack truck; but practice



shows that this arrangement does not lead to an easy handling of the sack truck what immediately else should be expected. The best location, it has been found, is a positioning some what higher up underneath the platform body, but, on the other hand being reasonably close to the sets of wheels.

Nothing prevents, that the hand truck may comprise driven supporting wheels. It is thus possible that the hand truck as well only comprises one supporting wheel - i.e. barrowlike - as comprises three or more supporting wheels which each could be constructed as a starlike configuration of wheels.

A particular advantage of the construction compared to that of the state of the Art furthermore is that the hand truck equally well may be used at stairs of an open structure, i.e. stairs which only comprise horizontal land area means, as at stair cases of a more closed structure, i.e. comprising vertical connecting plates between the front range of the single plate shaped land area means and down to the rear range of the land area positioned underneath. Difficulties will be met when the known hand trucks are to be used as well for open structured stair cases as for stair cases where the mentioned connecting plate between the stairs has a position being displaced just somewhat more to the rear, as it will be difficult, if not impossible, to get the holding means turned into position for climbing the following of the stairs, etc. Further difficulties will also be met as mentioned when loading and unloading goods for transportation by means of a hand truck of the sack truck type, which type possibly, but not exclusively, should be of the preferred structure to be used according to the invention.

Embodiments according to the invention are described in more details in the following with reference to the drawing, in which:



Fig. 1 in the perspective illustrates a hand truck fitted as a sack truck according to the present invention,

Fig. 2 and 3 in two versions show longitudinal sections through the hand truck illustrated in Fig. 1,

Fig. 4 in the perspective illustrates a third version as according to Fig. 1,

Fig. 5 in the perspective shows a bottom plate for the embodiment according to Fig. 4, and

Fig. 6 illustrates the lower half of the hand truck according to Fig. 4 seen from below and with a bottom plate, as according to Fig. 5, being dismantled.

A hand truck illustrated in Figure 1 and Figure 2 is constructed as a sack truck comprising side members 6, handles 7 and crossbars 15 between the side members 6 as well as a forward pointing sack lifting member 8. The truck is fitted with supporting wheels 1, 2 and 3 of which only the supporting wheels at one side of the truck are indexed with reference numerals. The supporting wheels 1, 2 and 3, i.e. the supporting wheels of both sides of the truck, are, in starlike configurations, held in position on the truck by means of a holding means 4 having a starlike configuration. The holding means 4 is held by a horizontal through-going shaft 5 carried by bearings in the side members 6 or by means of bearing pedestals, etc., on the side members. The shaft 5 carries a worm wheel 9 which by a worm 16, which is not shown in Figure 1, is driven by a shaft 10 directly or through a suitable gear, possibly a gear comprising possibility for changing between two or more gear ratios if such in particular cases should be wanted such as in case of transportation of very heavy and of very low weights of goods by means of the same hand truck, and where the shaft 10 is driven by

for instance an electric motor 11 receiving energy supply from batteries in battery boxes 12 and 13. By means of activating handles 17 and 18 the electric motor 11 can be brought to start or to stop and by means of the other 5 handle respectively brought to rotate in one or other direction.

The hand truck is used in the way that the motor is activated so that for instance the supporting wheels 3 and 4 simultaneously rest against the floor while the hand 10 truck is slanted to a position in which the front end of the sack lifting member 8 touches the surface of the supporting means which carries sacks or other goods to be lifted by means of the hand truck. With two supporting wheels resting against the surface of this supporting 15 means the lowest possible level of the platform body means of the sack truck is attained. In case the goods to be carried are positioned higher up the holding means 4 may be turned by means of the electric motor unto a suitable loading position for the hand truck is attained. The goods 20 are loaded on the hand truck, whereby the electric motor 11 possibly might be activated for simultaneously rotating the holding means 4 so that the height level of the platform body of the hand truck becomes further increased. The sack truck is tilted back to a suitable slanting position 25 to be used for the transportation whereby the electric motor 11 again may be activated to achieve this, preferably a position of the hand truck may be used where only one pair of supporting wheel rests against the floor, namely a pair of wheels with a wheel on each side of the 30 sack truck which thus are resting against the floor. In a per se known manner the sack truck is driven away from the loading spot, and if, as earlier explained, an obstacle as a staircase leading upwards or downwards is met, the electric motor 11 is activated to rotate the holding means so that 35 changing of wheels takes place when climbing the single stairs.

An embodiment of the hand truck could be contemplated where the supporting wheels are driven by a tooth wheel comprising, a drive belt comprising or a drive chain comprising drive means driven by a single drive motor or by 5 drive motors being separately arranged in the hubs of the single wheels, etc. It is the aim by means of the embodiment according to the invention that it not should be necessary with a positive drive of the supporting wheels in case of hand trucks of small or medium size, just as 10 it has been described above. In case of very heavy trucks such a drive means for the supporting wheels may be required.

An embodiment of the hand truck which could be contemplated is a hand truck, for instance constructed as a 15 sack truck, where behind the platform body, i.e. as a to the rear protruding prolongation of the sack lifting member 8, a stepping plate is provided. This stepping plate may be used when lifting especially one end of very heavy goods, such as the end of large rolls of paper, so 20 that the hand truck, which in this case preferably may be provided with a drive means for the rolling of it, may be used to push such particularly heavy objects along a supporting floor. In this case it could due to economical reasons furthermore be advantageous that the in starlike 25 configurations on the holding means arranged supporting wheels possess different sizes, so that the most powerful s.c of wheels then can be located most closely to the heavy object to move. At such an embodiment the holding means 4 may be thus constructed that it lends itself to 30 be fixed, i.e. kept by locking in an attained position, whereby the drive mechanism for the rotating of the holding means for such purpose to avoid an expensive overdimensioning of the components, to respond to such a heavy load, in practice is made inoperative during such a 35 working operation, which occasionally may take place.

To be used at stair cases having stairs of small height difference and of large width the starlike configurations of the supporting wheels may be arranged to comprise only two wheels on each side of the hand truck as a cheaper version according to the invention. Configurations comprising more than three wheels shown in the Figures of the drawing might also be considered as an advantageous solution, as well as configurations of irregular kind, but though preferably equally configured in pairs with pair members on each side of the truck, might also be contemplated. Embodiments with wheel configurations on more than two sides of the truck may be contemplated in case of trucks which without turning shall be able to be driven in more than one direction, and in which case also the holding means 8 are positioned able to be lifted and lowered. Such an embodiment could also be provided in the way that the supporting wheels generally or singly are mounted able to be turned towards different directions, so that the hand truck, for instance at a stair case land area, is able to be driven further on in a direction sideways to the direction of approach, along a next stair case, or in case the hand truck has to be driven to a congested location for being loaded or unloaded.

A remarkable feature of the hand truck is that the hand truck according to the invention is able to climb stair cases and doorsteps and obstacles on the ground in the open field, such as kerbstones, at a larger velocity than the hand trucks belonging to the state of the Art are able to, and this is attained without a too large net weight of the truck.

In this respect it is an advantage that the moments of inertia of the rotary items or the moments of inertia of particularly the more fast rotating transmission elements are large subsidiary that they are furnished with a fly-wheel. In this way the motor may be dimensioned to be less



and have a lower weight in general and that the motor, in case it is an electric motor, may have a low current consumption at a given working voltage. Thus, by embodiments according to the invention supply of energy is only  
5 required for a short time period just when passing single obstacles. In this way also a fast passage of the obstacle is attained, as the moment of inertia momentarily is available during the passage yielding an aiding energy supply. Before passage of the following obstacle the rotational  
10 velocity, to enable a sufficiently fast passage of the obstacle, has to be reattained sufficiently fast so that a safe passage is safeguarded. By employing embodiments according to the invention practical experiments have shown that this feature is attained. A hand truck, such as  
15 a sack truck, of such embodiments is capable of passing a stair case at a speed corresponding to that of walking at comfortable speed, whereas contrary hereto embodiments according to the state of the Art are operating more times more slowly and moreover, they are more difficult to  
20 handle.

In Figure 3 of the drawing another assembly of the elements is shown, whereby these are thus arranged that a further transmission element also is required, such as a chain drive 19, but the more heavy elements are located  
25 more close to the shaft 5, and the supporting wheel arrangement is located fully under the rear side of the truck, so across the hand truck gives more ample space for goods than the embodiment of the truck according to Figure 1 is able to perform. Possibly, the transmissions element  
30 19 may yield a changeable gear ratio enabling a changing of the velocity at passing obstacles.

In Figures 4, 5 and 6 a third assembly of the elements is illustrated. By this embodiment the hand truck is constructed also as a kind of sack truck comprising a  
35 detachable platform body 8 which easily can be exchanged

with for instance a more projecting sack platform 8 for for instance transportation of beer cases, and the platform 8 may in a well known manner be hinged to the hand truck and be up-foldable.

5 The sack platform 8 is mounted to the outer upper bottom surface 68 of a box with side members 72. The lower side of the box is open, but may be closed by means of a detachable bottom cover which is shown in Figure 5 and comprises as well an even plate portion 74 as a transversely projecting cover portion 73 serving to cover the wheel axis range as further described in the following. The advantage of this box structure is as well the protection of the single drive elements of the hand truck as that the projecting portion of the cover 73 is able to serve as a foot rest when tilting the hand truck upwards when more heavy goods are carried on the cargo platform 8. The box might alternatively possess lesser depth than shown in Figure 4 in which case a single similar projection as 73 then is arranged rectangular hereto serving the purpose to cover the drive means 11 which also is described in more detail in the following.

In Figure 6 the box structure according to Figure 4 is shown, but seen from below. In per se known manner a battery 12 is mounted by means of an angular plate means 25 72 which holds the battery 12 to the bottom surface 68 of the box structure. The drive means 11, which can be an electric motor, drives through a gear 56, which simultaneously carries the drive means 11, a double transmission chain 79 driving an output sprocket which in the vicinity of a supporting bearing 61 is mounted on the shaft 5 which 30 at the ends carries holding means 4. The supporting bearings 61 may be bearings which for instance are dismantable in two halves so that all rotary items may be taken out at once when holding screws 69 which as well 35 hold the drive means 61 to the bottom surface 68 as serve



as chain tighteners for the transmission chain 79 also are removed. An easy service access to the internal items is thus achieved in this way.

There is referred to for instance electric contactors 5 and branching connecting elements being part of the electric control of the drive means 11 by means of reference numeral 71.

Besides handles 7, at the vicinity of which preferably for instance control mode changing activating means for the control of the drive means 11 such as a reversing control means 76 and an on-off-switch 75 are located, a in proportion to the hand truck transversely orientated handle 77 is arranged. It makes a comfortable one-hand control of the hand truck possible. The handle 77 preferably comprises only an on-off-switch 75 which is arranged upwards projecting.

The activating means 75, 76 should preferably be located on the external sides of these as it else, by a bodily push against the handles 7 with the purpose to move around a for instance particularly congested corner area in a corridor with the hand truck, may occur that the drive means 11 becomes wrongly operated. The activating means 75, 77 make a one-hand-operation of the hand truck possible.

If, as hinted at, the cover means according to Figure 5 as described possesses a further projecting range to cover for instance the drive means 11, it is possible to employ a lesser box depth. On the other hand, practical experiences show that the hand truck according to Figures 4, 5 and 6 besides exhibiting a higher reliability due to the covered means also has a structure which permits transportation of even rather heavy goods, just as it is an advantage that the heavy goods easily can be unloaded by sideways pushing of the goods so that loading and unloading is possible within a larger height range than it is





possible with a hand truck of the sack truck type as according to Figures 2 and 3. The hand truck is easily also capable of passing door steps, besides as according to the purpose, to transport heavy goods upstairs and 5 downstairs.

According to the invention a hand truck with a handle configuration is achieved being well suited for transportation of heavy goods exhibiting a centre of gravity which is located far from the surface where the goods 10 rest against the hand truck. The drive means may be arranged at a low location within the truck and the hand truck is also well suited to serve as a stretcher, as a wheel chair and also for the transportation of equipment for disabled persons to which services the known trucks of 15 this kind not easily may be converted and afterwards are not as easy to handle as the hand truck of the invention.

The hand truck can during operation be used occupying an only very little slanting position being the case also when passing stair cases as when operated in an even open 20 field.

# CLAIMS

1. Stair climbing hand truck of the kind comprising a rotary holding means carrying supporting wheels arranged setwise in starlike configurations characterized therein that the holding means (4) for a starlike configuration of supporting wheels (1, 2, 3) is rotary positioned and may be rotated by means of a drive means (11) which is either of the self-locking kind, as for instance a drive means comprising a worm gear (16, 9), or is able to be locked, by means of a disengageable braking- or locking mechanism, in an attained position after a terminated rotary movement.

2. Stair climbing hand truck according to claim 1 characterized therein that the activation of the drive means (11) or of a possible braking- or locking mechanism is manually providable by means of activating means (17, 18) being arranged at the steering handles (7) on the hand truck.

3. Stair climbing hand truck comprising two sets of supporting wheels of starlike configurations, as for instance of sack truck type, according to claim 1 or 2 characterized therein that the drive means (11, 12, 13) for the attainment of best location of the centre of gravity within the truck is located underneath the cargo and in the near neighbourhood of the set of supporting wheels

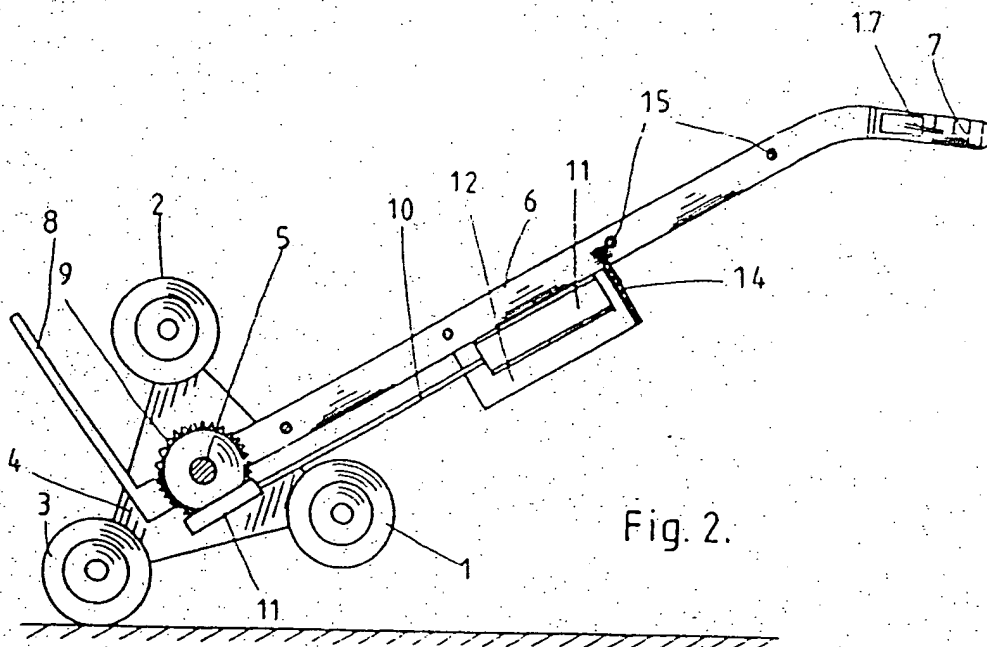
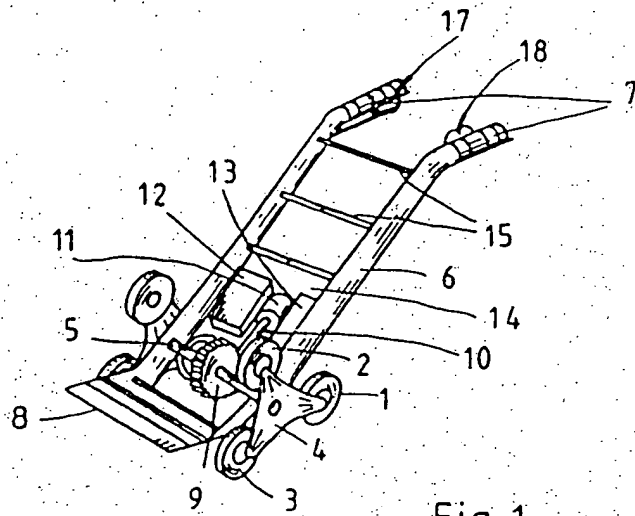
4. Stair climbing hand truck according to claim 1, 2 or 3 characterized therein that to achieve a delivery of a short time energy supply at the single obstacles to be passed a drive motor is used possibly exhibiting an underdimensioned energy yield but where the moment of inertia of the motor and/or the moment of inertia of with the motor connected transmission means is large or is comparatively large.

5. Stair climbing hand truck according to claim 1, 2, 3 or 4 to be usable for transportation, respectively pushing, of also especially heavy goods characterized therein that the used starlike configuration(s) of supporting wheels (1, 2, 3) each or readjustable comprise(s) wheels (1, 2, 3) of different sizes.

6. Stair climbing hand truck according to claim 1, 2, 3, 4 or 5 characterized therein that the control handle (7, 77) comprises separate activating control mode changing means for respectively reverse control of the drive means (11) respectively for on-off-control of the drive means (11) comprising alternatively one set for each handle (7), and moreover an activating on-off-control means located on an on the hand truck transversely orientated handle means (77) which preferably is arranged upwards projecting.

7. Stair climbing hand truck according to claim 1, 2, 3, 4, 5 or 6 characterized therein that the drive means (11) is located at the upper bottom surface (68) of a box structure being the lower portion of the hand truck, which for instance could be of sack truck type, and where a preferably double and in the vicinity of one of the main bearings (61) of the wheel shaft arranged transmission chain drive connects the output shaft of the drive means (11) with the drive shaft (5) for the holding means (4), and where preferably fastening spanning means, such as bolt-nut connecting elements, as well hold the drive means (11) in position in proportion to the bottom surface (68) as serve as chain tighteners for the transmission chain.

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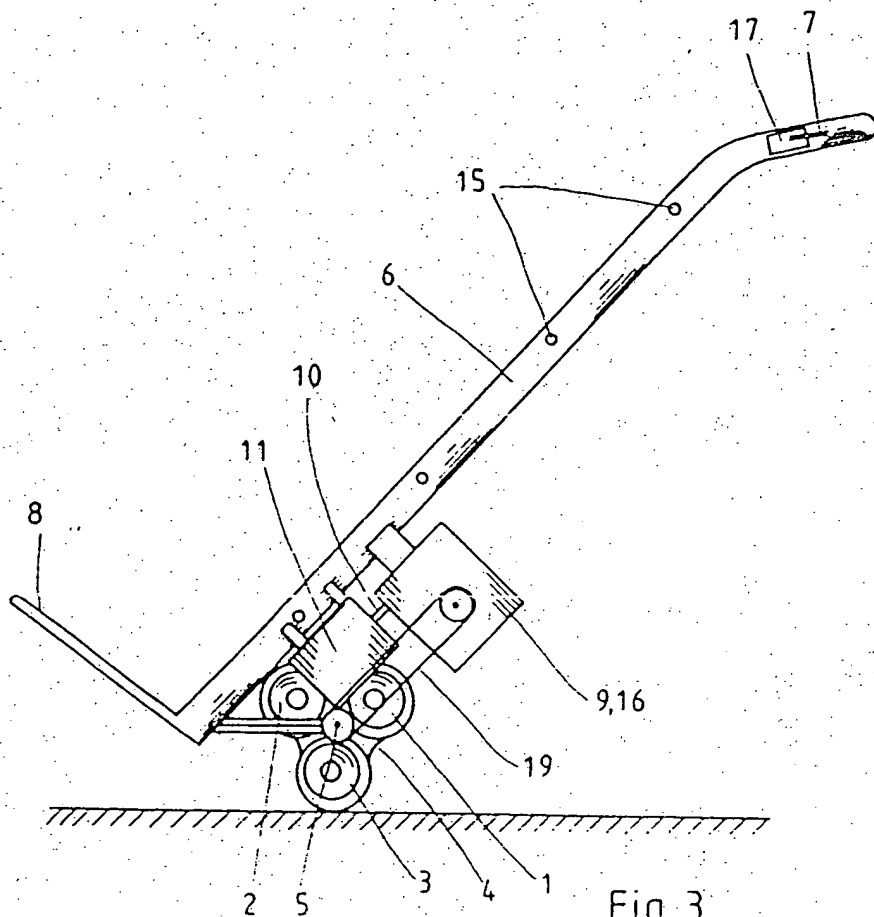


Fig. 3.

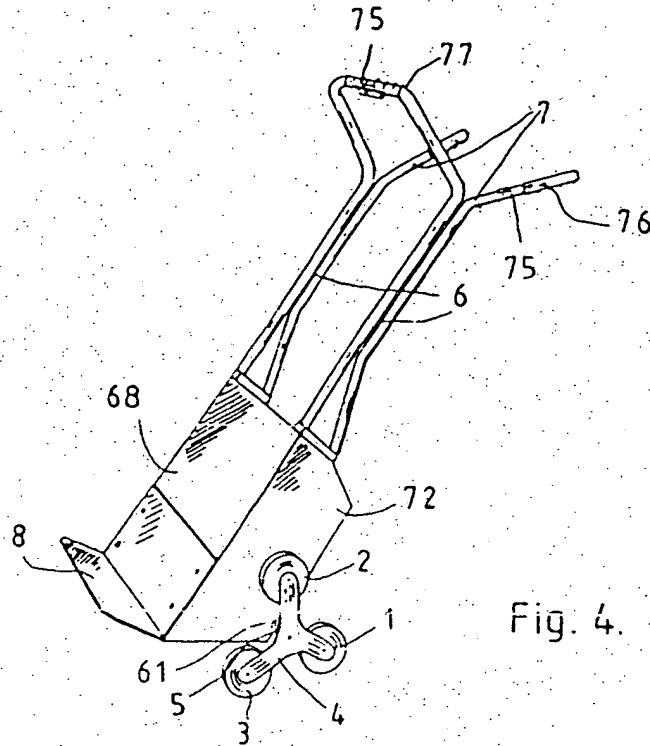


Fig. 4.

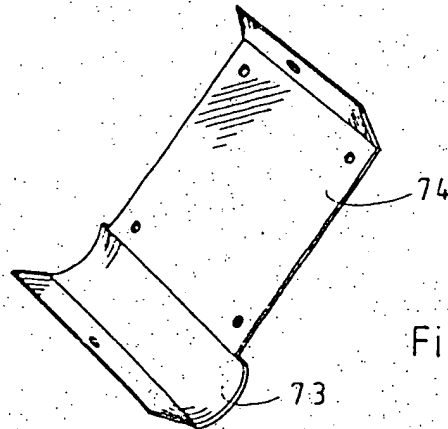


Fig. 5.

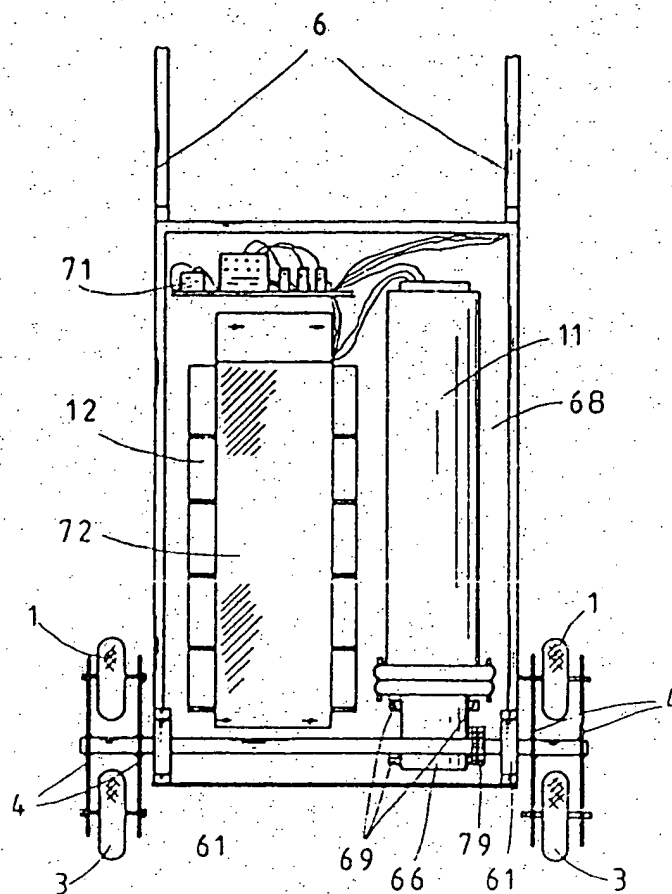


Fig. 6.

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## INTERNATIONAL SEARCH REPORT

PCT/DK86/00028

International Application No.

<b>I. CLASSIFICATION OF SUBJECT MATTER</b> (If several classification symbols apply, indicate all) *		
According to International Patent Classification (IPC) or to both National Classification and IPC 4		
B 62 B 5/02		
<b>II. FIELDS SEARCHED</b>		
Minimum Documentation Searched *		
Classification System	Classification Symbols	
IPC	B 62 B 9/00, /02, 5/00, /02, /06	
Nat C1	63b:6, 16	
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Documentation Searched other than Minimum Documentation to the extent that such documents are included in the fields searched *		
SE, NO, DK, FI classes as above		
<b>III. DOCUMENTS CONSIDERED TO BE RELEVANT *</b>		
Category *	Citation of Document, ** with indication, where appropriate, of the relevant passages **	Relevant to Claim No. **
X	DE, A, 2 124 284 (FRANZ FUCHS) 30 November 1972 & FR, 2137851	1-7
X	DE, A1, 3 209 457 (TOBEX MOTIVATED CHAIR CO LTD.) 1 January 1983 & FR, 2502090 GB, 2098144 US, 4421189 GB, 2112330	1-7
X	DE, A1, 3 242 880 (T.G.R. S.R.L.) 23 June 1983	1-7
X	FR, A, 1 310 268 (C. LOCOLAS, B. SÉNÉCHAL) 15 October 1962	1-7
X	FR, A5, 2 050 542 (J. FLEMING) 2 April 1971	1-7
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<b>IV. CERTIFICATION</b>		
Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report	
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Form F

## FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

V. ☐ OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE

This International Search report has not been established in respect of certain claims under Article 17(2) (a) for the following reasons:

☐ Claim numbers ..... because they relate to subject matter not required to be searched by this Authority, namely:

☐ Claim numbers ..... because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

☐ Claim numbers ..... because they are dependent claims and are not drafted in accordance with the second and third sentences of PCT Rule 8.4(a).

VI. ☒ OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING

This International Searching Authority found multiple inventions in this international application as follows:

Claims 1, 2-5 and 7 refer to a driving unit.  
Claims 2 and 6 refer to activating means.

☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application.

☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims:

☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers:

☐ As all searchable claims could be searched without effort justifying an additional fee, the International Searching Authority did not invite payment of any additional fee.

## Remarks on Protest

☒ The additional search fees were accompanied by applicant's protest.

☐ No protest accompanied the payment of additional search fees.



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